201-15730

HIGH PRODUCTION VOLUME (HPV) CHALLENGE PROGRAM

REVISED TEST PLAN

AND ROBUST SUMMARIES

FOR

POLYPHOSPHORIC ACID ESTERS OF TRIETHANOLAMINE, SODIUM SALTS

CAS NO. – 68131-72-6

PREPARED BY:

ARCH CHEMICALS, INC.

November 30, 2004

TABLE OF CONTENTS

OVERVIEW

Arch Chemicals, Inc. (Arch) submits the revised test plan and robust summaries for polyphosphoric acid esters of triethanolamine, sodium salts (CASRN – 68131-72-6) under the Environmental Protection Agency's High Production Volume Chemical Challenge Program. It is the intent of Arch to use a combination of existing data for triethanolamine (CASRN – 102-71-6) and bridging data from polyphosphoric acid esters of triethanolamine, sodium salts to adequately fulfill the Screening Information Data Set (SIDS) for the physical/chemical endpoints, environmental fate, ecotoxicity and human health-related toxicology. The endpoints for polyphosphoric acid esters of triethanolamine, sodium salts will be satisfied by bridging data from triethanolamine following completion of abiotic hydrolysis (hydrolysis as a function of pH) and enzymatic hydrolysis studies that Arch anticipates will show that polyphosphoric acid esters of triethanolamine, sodium salts hydrolyzed to triethanolamine and inorganic phosphate. In addition, Arch proposes to conduct two studies in the area of physical/chemical endpoints for polyphosphoric acid esters of triethanolamine, sodium salts to show similarity to triethanolamine. They are water solubility and octanol/water partition coefficient.

Polyphosphoric acid esters with triethanolamine is an amber liquid having a very mild ammonia odor. This chemical is an aqueous surfactant solution containing a partially neutralized mixture of triethanolamine polyphosphoric acid esters. It is used to activate a glutaraldehyde-based formulation to sterilize medical instruments. It has also been used as an agent to inhibit scale in water systems. The pH of a 5 % solution in neutral distilled water is in the range of 4-6.

The average composition of the final product can be calculated from the result of (a) direct analysis of the product for orthophosphate, which is a direct measure of the amount of sodium dihydrogen phosphate byproduct formed by competitive reactions, (b) direct analysis of the product for total solids and (c) a knowledge of the amounts of raw materials charged at the beginning of the reaction. Specifications for this chemical are 70% minimum total solids and 20% maximum orthophosphate. At these limits, the average product composition calculates to be a mixture of diester and monoester in a mole ratio of about 3:2. As orthophosphate goes down (but total solids stay the same) this ratio gets larger, i.e. there is more diester and less monoester, until at an orthophosphate level of 12.2%, the product is all diester. Typical total solids are 70-72% and the typical orthophosphate level is 14-18%. The actual product composition will vary somewhat from this theoretical average and will probably include small amounts of both triester and free triethanolamine.

JUSTIFICATION FOR USE OF TRIETHANOLAMINE AS A SURROGATE FOR POLYPHOSPHORIC ACID ESTERS OF TRIETHANOLAMINE

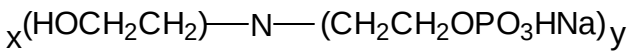
Polyphosphoric acid esters with triethanolamine, sodium salts is manufactured as an aqueous solution from polyphosphoric acid, triethanolamine and sodium hydroxide. This material is a mixture of tri-, di-, and monophosphate esters of triethanolamine and

consequently is classified with a range of molecular weight. Thus, the molecular weight ranges from 251 for the sodium salt of the monophosphate ester to 455 for the sodium salt of the triphosphate ester. The difference in molecular weight is due to the varying amount of sodium and phosphate groups. Triethanolamine is a pale yellow hygroscopic viscous liquid with a melting point of 21°C. It has a vapor pressure of <0.01 mm Hg at 20°C (Howard, 1990). Both triethanolamine (Howard, 1990) and polyphosphoric acid esters with triethanolamine, sodium salts are miscible with water. The molecular structure of the two chemicals is similar. In the synthesis of polyphosphoric acid esters with triethanolamine, sodium salts the structure of triethanolamine is modified only by the presence of a phosphate group with sodium at the end of one or more of the ethanol groups.

The phosphate groups would not increase the toxicity of triethanolamine and, in all likelihood, would decrease it to both mammals and aquatic organisms. Metabolically, it is predicted that polyphosphoric acid esters with triethanolamine, sodium salts will undergo hydrolysis resulting in removal of the phosphate groups from triethanolamine. The phosphate groups would then be available to enter the general phosphate pool of the body. The toxicity of phosphate is low and in fact, phosphate is critical to normal physiological function of the body. Removal of all the phosphate groups results in triethanolamine, the chemical that will serve as the surrogate to define the physical/chemical properties, environmental fate, aquatic toxicity and mammalian toxicity of polyphosphoric acid esters with triethanolamine, sodium salts.

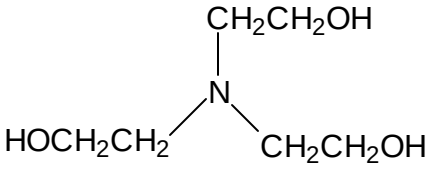
Comparison of the chemical structure between polyphosphoric acid esters with triethanolamine, sodium salts and triethanolamine

- **Polyphosphoric acid esters with triethanolamine, sodium salts**



Where
x = 1 - 2
y = 1 - 2

- **Triethanolamine**



TEST PLAN SUMMARY

Polyphosphoric acid esters with triethanolamine, sodium salts CAS # 68131-72-6	Information	OECD Study	Other	Estimation	GLP	Acceptable	New Testing Required
STUDY	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N
PHYSICAL-CHEMICAL DATA							
Melting Point[2]	N/A	-	-	-	-	-	N/A
Boiling Point[2]	N/A	-	-	-	-	-	N/A
Vapor Pressure[1]	Y(S)	N	Y(S)	N	N	Y	N
Partition Coefficient	N	-	-	-	-	-	Y
Water Solubility	N	-	-	-	-	-	Y
ENVIRONMENTAL FATE DATA							
Photodegradation[1]	Y(S)	N	Y(S)	N	N	Y	N
Stability in Water	N						Y
Biodegradation[1]	Y(S)	N	Y(S)	N	N	Y	N
Transport between Environmental Compartments (Fugacity)[1]	Y(S)	N	Y(S)	Y	N	Y	N
ECOTOXICOLOGICAL DATA							
Acute Toxicity to Fish[1]	Y(S)	N	Y(S)	N	N	Y	N
Acute Toxicity to Aquatic Invertebrates[1]	Y(S)	N	Y(S)	N	N	Y	N
Toxicity to Aquatic Plants[1]	Y(S)	N	Y(S)	N	N	Y	N
MAMMALIAN TOXICOLOGICAL DATA							
Acute Toxicity[1]	Y(S)	N	Y(S)	N	N	Y	N
Repeated Dose Toxicity[1]	Y(S)	N	Y(S)	N	N	Y	N
Genetic Toxicity[1]							
Mutation[1]	Y(S)	N	Y(S)	N	N	Y	N
Chromosomal Aberration[1]	Y(S)	N	Y(S)	N	N	Y	N
Developmental Toxicity[1]	Y(S)	N	Y(S)	N	N	Y	N
Toxicity to Reproduction[1,3]	N(S)	N	Y(S)	Y	N	Y	N

Footnotes

1 – The designation, (S), signifies that the available information or conclusion regarding an endpoint is for the surrogate, triethanolamine. For those endpoints with the entry N in the Information Column, Arch proposes to conduct the specific study corresponding to each entry. Additionally, Arch proposes to conduct a study to determine the ability of

polyphosphoric acid esters with triethanolamine, sodium salts to undergo enzymatic hydrolysis. These studies will allow bridging of polyphosphoric acid esters with triethanolamine, sodium salts to the data for triethanolamine.

2 – Not applicable. Polyphosphoric acid esters with triethanolamine, sodium salts is supplied as an aqueous solution.

3 – No studies have been conducted to specifically evaluate the effect of triethanolamine on reproductive performance. However, based on consideration of the repeat dose toxicity studies of at least 90 days duration, there were no abnormalities noted in the histopathological examination of reproductive organs. This fact, and the lack of effects on development, allow the conclusion that triethanolamine would not be expected to produce toxicity to reproductive performance and fertility. The OECD SIDS Initial Assessment Report (Report) concurs with this opinion. The Report states, "Although there were no studies available on fertility, there were no abnormalities noted in the histopathological examination of reproductive organs (testes and ovaries) in the 90-day oral and dermal toxicity studies. Triethanolamine is not a developmental or reproductive toxin."

TEST PLAN DESCRIPTION FOR EACH SIDS ENDPOINT

A. Physical/Chemical Endpoints for Triethanolamine

Melting Point – This endpoint is not applicable. Polyphosphoric acid esters with triethanolamine, sodium salts is supplied as an aqueous solution.

Boiling Point – This endpoint is not applicable. Polyphosphoric acid esters with triethanolamine, sodium salts is supplied as an aqueous solution.

Vapor Pressure – A value for this endpoint for triethanolamine was obtained from a standard reference text (Howard, 1990). Polyphosphoric acid esters with triethanolamine, sodium salts will be bridged to the data for triethanolamine to predict the vapor pressure.

Partition Coefficient – No data exists for this endpoint for polyphosphoric acid esters with triethanolamine, sodium salts. Arch proposes to conduct a study according to OECD (TG 107) guidelines and GLP standards to obtain a value for this endpoint.

Water Solubility – No data exists for this endpoint for polyphosphoric acid esters with triethanolamine, sodium salts. Arch proposes to conduct a study according to OECD (TG 105) guidelines and GLP standards to obtain a value for this endpoint.

Conclusion – As stated, the boiling point and melting point are not applicable for polyphosphoric acid esters with triethanolamine, sodium salts because it is supplied as a product in aqueous solution. Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will allow bridging of this chemical to triethanolamine for the endpoint of vapor pressure.
The endpoints for partition coefficient and water solubility will be determined for polyphosphoric acid esters with triethanolamine, sodium salts by conducting actual studies.

B. Environmental Fate Endpoints for Triethanolamine

Photodegradation – A value for this endpoint for triethanolamine was obtained from a standard reference text (Atkinson, 1987) and from a computer estimation model (AopWin v.1.90, 2000).

Stability in Water – No data exists for this endpoint for polyphosphoric acid esters with triethanolamine, sodium salts. Arch proposes to conduct a study according to OECD (TG 111) guidelines and GLP standards to obtain a value for this chemical. Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will allow bridging of this chemical to triethanolamine for this endpoint.

The half-life of triethanolamine is expected to range from a few days to a few weeks depending on the degree of acclimation of the system. Bioconcentration in aquatic organisms, adsorption to suspended solids and sediments, and volatilization are not expected to be important fate processes in water. Triethanolamine does not decompose or hydrolyze in contact with water and there is no abiotic degradation (Howard, 1990).

Biodegradation – This endpoint for triethanolamine was satisfied using data from published studies (Gerike and Fischer, 1979; Zahn and Wellens, 1980). The data indicate that triethanolamine is inherently biodegradable. In the ready biodegradation tests, triethanolamine was readily biodegradable in the AFNOR (97% degradation based on DOC removal), STURM (91% degradation based on CO_2 evolution) and OECD Screening test (96% degradation based on DOC removal, but little degradation was observed in the MITI (14 day test; 2% removal based on BOD and Closed Bottle (0-9% removal based on BOD) (SIDS Initial Assessment Report). The SIDS Initial Assessment Report concluded that triethanolamine is readily biodegradable, possibly after a short acclimation period and that extensive removal due to biodegradation is to be expected in sewage treatment plants. Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will allow bridging of this chemical to triethanolamine for this endpoint.

Fugacity – This endpoint for triethanolamine was satisfied using data from intracompany correspondence (Comber, 1993. ICI Chemicals). Due to the high water solubility and low vapor pressure of triethanolamine, it partitions itself preferentially into the water phase from which volatilization to the atmosphere will be only a minor removal process. The low log Kow value indicates that bioaccumulation and adsorption of triethanolamine onto soils/sediments is unlikely to occur. Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will allow bridging of this chemical to triethanolamine for this endpoint.

Conclusion – All endpoints for triethanolamine have been satisfied using actual data, through the use of EPA-acceptable estimation models, standard reference texts, or, in the case of stability in water, scientific judgment to support the position for testing requirements. No additional testing is needed in the area of environmental fate. Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts, the endpoints for environmental fate will allow bridging of this chemical to triethanolamine for the endpoints for environmental fate.

C. Ecotoxicity Endpoints for Triethanolamine

Acute Toxicity to Fish – This endpoint for triethanolamine was satisfied using data from aquatic toxicity studies published in the open literature (Birdie et al., 1979; Geiger et al., 1987). Two freshwater species were used – *Carassius auratus and Pimelphales promelas*. The LC_{50} (24 to 48-hour exposure) was greater than 1000 mg/l to both species. Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will allow bridging of this chemical to triethanolamine for this endpoint.

Acute Toxicity to Aquatic Invertebrates – This endpoint for triethanolamine was satisfied using data from aquatic toxicity studies published in the open literature (Bringman and Kuhn, 1982; Bringman and Kuhn, 1987). The test species was *Daphnia magna*. The EC_{50} (24-hour exposure) was greater than 1000 mg/l. Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will allow bridging of this chemical to triethanolamine for this endpoint.

Toxicity to Aquatic Plants – This endpoint for triethanolamine was satisfied using data from aquatic toxicity studies published in the open literature (Amann and Stainhauser, 1986; Kuhn and Pattard, 1990). The test species was *Scenedesmus subspicatus*. The EC_{50} (72 to 96-hour exposure) ranged from 169 to 910 mg/l. The difference was dependent upon the pH with the non-neutralized triethanolamine exerting the greater toxicity. Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will allow bridging of this chemical to triethanolamine for this endpoint.

Conclusion – All endpoints for triethanolamine have been satisfied using data from studies published in the open literature. Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will allow bridging of this chemical to triethanolamine for the endpoints for aquatic toxicity.

D. Mammalian Toxicological Endpoints for Triethanolamine

Acute Toxicity – The studies that satisfy this endpoint for triethanolamine were conducted prior to introduction of GLP. However, all studies (Oral LD_{50}, dermal LD_{50} and inhalation LC_{50}) to define the acute toxicological profile were conducted in accordance with currently accepted scientific principles and are considered reliable. The data indicate that triethanolamine is of low toxicity by the oral, dermal and inhalation routes of exposure. Oral LD_{50} values have been shown to range from approximately 5-10 g/kg (Smyth et al., 1951; Kindsvatter, 1940; Cosmetic Ingredient Review, 1983). The dermal LD_{50} is greater than 2 g/kg (Cosmetic Ingredient Review, 1983). The inhalation LC_{50} is greater than a saturated atmosphere (BASF AG, 1966). Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will allow bridging of this chemical to triethanolamine for this endpoint.

Repeat Dose Toxicity – The studies to determine toxicity of triethanolamine from repeated exposure were conducted for a duration of 91 days (CTFA, 1976) or 2 years (Maekawa et al., 1986). In both studies the NOAEL was at least 1000 mg/kg. There was no evidence of gross or histopathological change that could be attributed to treatment. Also, triethanolamine was shown to be non-carcinogenic in an oral exposure study. The National Toxicology Program conducted cancer bioassay studies using rats and mice, but the exposure was via the dermal route. These data were not presented as a robust summary because they are viewed as not adding significant information to the data base for triethanolamine and the fact that the International Agency for Research on Cancer (2000) concluded that there is inadequate evidence in experimental animals for the carcinogenicity of this chemical. Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will allow bridging of this chemical to triethanolamine for this endpoint.

Genetic Toxicity

Mutation (bacterial) – This endpoint for triethanolamine has been satisfied by two studies (Inoue et al., 1982; Mortelmans et al., 1986) using 4 strains (TA 98, TA 100, TA 1535 and TA 1537) of *Salmonella typhimurium*. Triethanolamine was not mutagenic in any of the tester strains.

Chromosomal aberration (mammalian, *in vitro*) – This endpoint for triethanolamine was satisfied by a cytogenetic assay using Chinese hamster lung cells (Inoue et al., 1982). Triethanolamine did not induce chromosome aberrations in this test system.

Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will allow bridging of this chemical to triethanolamine for the endpoints of genetic toxicity.

Reproductive Toxicity – No studies have been conducted to specifically evaluate the effect of triethanolamine on reproductive performance. However, based on consideration of the repeat dose toxicity studies of at least 90 days duration, there were no abnormalities noted in the histopathological examination of reproductive organs. This fact, and the lack of effects on fetal development, allow the conclusion that triethanolamine would not be expected to produce adverse effects to reproductive performance and fertility. Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will allow bridging of this chemical to triethanolamine for this endpoint.

Developmental Toxicity – This endpoint for triethanolamine was satisfied using a developmental toxicity screening study according to the Chernoff-Kavlock method (Pereira et al., 1987). Based on the results from this test, triethanolamine does not impair development of the fetus. Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will allow bridging of this chemical to triethanolamine for this endpoint.

Conclusion – The endpoints for acute toxicity, genetic toxicity, repeat dose toxicity and developmental toxicity for triethanolamine have been satisfied with data from studies that were conducted utilizing methods that are similar to established guidelines and are scientifically appropriate. The endpoint for reproductive toxicity has not been directly satisfied. However, based on consideration of the repeat dose toxicity studies of at least 90 days duration, there were no abnormalities noted in the histopathological examination of reproductive organs. As expressed in the SIDS Initial Assessment Report (SIAR), the endpoint for the reproductive toxicity of triethanolamine has been satisfied. Confirmation of the hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will allow bridging of this chemical to triethanolamine for the endpoints of mammalian toxicity.

SIDS DATA SUMMARY FOR TRIETHANOLAMINE

Triethanolamine is a high boiling liquid that is miscible with water. It has a low vapor pressure and a low log K_{ow}. Due to the high water solubility and low vapor pressure, triethanolamine is likely to partition preferentially into the water phase from which volatilization to the atmosphere is likely to be only a minor removal process. The low log K_{ow} indicates that bioaccumulation and adsorption onto soils/sediment is unlikely to occur. Triethanolamine is readily biodegradable.

The ecotoxicity of triethanolamine is low regardless of the test organism. The 96-hour LC_{50} to fish is in the range of 5,000-10,000 mg/l. The toxicity to the water flea is also low with the 24-hour EC_{50} greater than 1,000 mg/l. The 96-hour EC_{50} to algae is almost 1,000 mg/l for neutralized triethanolamine.

Triethanolamine is of low toxicity following single exposures. It is not genotoxic or carcinogenic. It does not impair development of the fetus and does not produce toxicity to the reproductive system. Also, it is judged not to impair reproductive performance or fertility based on its lack of developmental toxicity and histopathological change to the reproductive organs.

Hydrolysis of polyphosphoric acid esters with triethanolamine, sodium salts will result in the formation of triethanolamine and inorganic phosphate. Thus, it is the judgment of Arch Chemicals, Inc. that triethanolamine is an appropriate analog for use to predict the chemical/physical properties, environmental fate and aquatic and mammalian toxicity of polyphosphoric acid esters of triethanolamine, sodium salts (CASRN 68131-72-6).

The physical/chemical properties, environmental fate and aquatic and mammalian toxicological data for triethanolamine have been reviewed by the OECD High Production Volume Chemicals Program through a SIAR. Based on the evaluation of all the data presented in the SIAR, triethanolamine is presently considered of low priority for further work and moreover, no further toxicity testing is required.

EVALUATION OF DATA FOR QUALITY AND ACCEPTABILITY

The collected data for triethanolamine were reviewed for quality and acceptability following the systematic approach described by Klimisch et al. (1997). The codification described by Klimisch specifies four categories of reliability for describing data adequacy. They are:

1. Reliable without restriction: Includes studies or data complying with Good Laboratory Practices (GLP) procedures, or with valid and/or internationally accepted testing guidelines, or in which the test parameters are documented and comparable to these guidelines.

2. Reliable with restrictions: Includes studies or data in which test parameters are documented but vary slightly from testing guidelines.

3. Not reliable: Includes studies or data in which there are interferences, or that use non-relevant organisms or exposure routes, or which were carried out using unacceptable methods, or where documentation is insufficient.

4. Not assignable: Includes studies or data in which insufficient detail is reported to assign a rating, e.g., listed in abstracts or secondary literature.

REFERENCES

1. AopWin v.1.90. (EPI Suite™ v.3.10). Downloadable at http://www.epa.gov/oppt/exposure/docs/episuitedl.htm. ©2000 U. S. Environmental Protection Agency.

2. Atkinson, R. Inter. J. Chem. Knot 19: 799-828. 1987. Listed in: Howard, P. H. Handbook of Environmental Fate and Exposure Data for Organic Compounds. Lewis Publishers. 1990.

3. Amann, W. and A. Stainhauser. 1986. Umweltforschungsplan des BMI, UFOPLAN Nr. 102 05 308. im Auftrag des Umweltbundesamtes.

4. BASF AG. Abteilung Toxikologie. Unpublished report. ZST-Nr. SV/307. 1966.

5. Birdie, A. L., C. J. M. Wolff and M. Winter. 1979. The Acute Toxicity of Some Petrochemicals to Goldfish. Water Res. 13: 623-626.

6. Bringman, G. and R. Kuhn. 1982. Z. Wasser Abwasser Forsch. 15: 6-11.

7. Bringman, G. and R. Kuhn. 1987. Results of the damaging effect of water pollutants on *Daphnia magna*. Z. Wasser Abwasser Forsch. 20: 161-166.

8. Comber, M. I. H. Zeneca Brixham Environmental Laboratory. Letter to M. G. Penman. ICI Chemicals & Polymers Limited. 1993.

9. Cosmetic Ingredient Review. 1983. Final Report on the Safety Assessment of Triethanolamine, Diethanolamine and Monoethanolamine. J. Am. Coll. Toxicol. 2 (7): 173-235.

10. CTFA. 1976. Submission of data by CTFA (2-5-55). 91-Day subchronic oral toxicity using triethanolamine. Cited in CIR. 1983.

11. Geiger, D. L., L. T. Brooks and D. J. Call. Acute Toxicities for Organic Chemicals to Fathead Minnows (*Pimephales promelas)*. Volume V. Center for Lake Superior Environmental Studies, University of Wisconsin – Superior. 1984-1988.

12. Gerike, P. and Fischer, W. K. 1979. A Correlation Study of Biodegradability Determinations with Various Chemicals in Various Tests. ECETOX. Environ. Safety. 3: 159-173.

13. Howard, P. H. Handbook of Environmental Fate and Exposure Data for Organic Compounds. Lewis Publishers. 1990.

14. Inoue, K., T. Sunakawa, K. Okamoto and Y. Tanaka. 1982. Mutagenicity tests and in vitro transformation assays on triethanolamine. Mut. Res. 101: 305-313.

15. International Agency for Research on Cancer. 2000. Triethanolamine. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: *Some Industrial Chemicals.* Vol. 77: 381-401. World Health Organization. Lyon, France.

16. Kindsvatter, V. H. 1940. Acute and chronic toxicity of triethanolamine. J. Indus. Hyg. Toxicol. 22 (6): 206-212.

17. Klimisch, H.-J., Andreae, M. and Tillman, U. 1997. A Systematic Approach for Evaluating the Quality of Experimental Toxicological and Ecotoxicological Data. Regul. Toxicol. Pharmacol. 25, 1-5.

18. Kuhn, R. and M. Pattard. 1990. Results of the Harmful Effects of Water Pollutants to Green Algae (*Scenedusmus subspicatus)* in the Cell Multiplication Inhibition Test. Water Res. 24: 31-38.

19. Maekawa, A., H. Onodera, H. Tanigawa, K. Furuta, J. Kanno, C. Matsuoka, T. Ogiu and Y. Hayashi. 1986. Lack of Carcinogenicity of Triethanolamine in F344 Rats. J. Toxicol. Environ. Health. 19: 345-357.

20. Mortelmans, K., S. Haworth, T. Lawlor, W. Speck, B. Tainer and E. Zeiger. 1986. *Salmonella* Mutagenicity Tests: II. Results from the Testing of 270 Chemicals. Environ. Mut. 8, Supplement 7: 1-119.

21. Pereira, M. P. Barnwell and W. Bailes. 1987. Screening of Priority Chemicals for Reproductive Hazards. Monoethanolamine, Diethanolamine and Triethanolamine. Environmental health Research and Testing, Inc. Cincinnati, OH. Project # 200-84-2735.

22. SIDS Initial Assessment Report for Triethanolamine. UNEP Publications.

23. Smyth, H. F., Carpenter, C. P. and Weil, C. S. 1951. Range-finding toxicity data: List IV. Arc. Ind. Hyg. Occ. Med. 4: 119-22.

24. Zahn, R. and Wellens, H. 1980. Examination of Biological Degradability through the Batch Method – further Experience and New Possibilities of Usage. Z. Wasser Abwasser Frosch. 13: 1-7.